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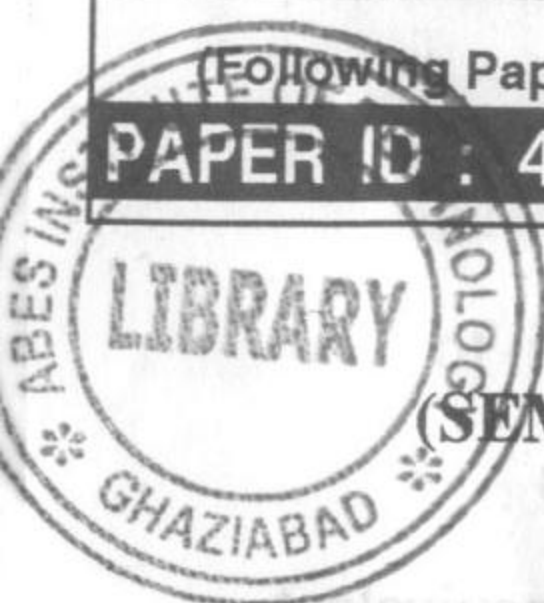
EME – 102 / EME – 202

(Following Paper ID and Roll No. to be filled in your Answer Book)

PAPER ID : 4303

Roll No.

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**B. Tech.**

**(SEM. II) EXAMINATION, 2008-09**

**ENGG. MECHANICS**

*Time : 3 Hours]*

*[Total Marks : 100*

**Note :** (1) This paper is in **three** sections. Section A carries 20 marks, Section B carries 30 marks and Section C carries **50** marks.

(2) Attempt **all** questions. Marks are indicated against each question/part.

(3) Assume missing data suitably, if any.

### **SECTION - A**

1 You are required to answer all the parts : **2×10=20**

Choose correct answer for the following parts :

(a) In order to determine the effects of a force acting on a body, we must know :



- (i) its magnitude
  - (ii) its direction
  - (iii) position or line of action
  - (iv) all of these
- (b) D'Alembert's principle is used for :
- (i) determining the stresses in truss
  - (ii) reducing kinetics problem to equivalent statics problem
  - (iii) stability of floating bodies
  - (iv) solving kinematics problem

**Fill in the blanks for the following three parts :**

You will be awarded full marks, if all the entries in a part are correct otherwise will be awarded zero.

- (c) A truss is said to be rigid in nature when there is no \_\_\_\_\_ on application of any external \_\_\_\_\_.
- (d) The centre of gravity of a semicircle lies at a distance of \_\_\_\_\_ whereas centre of gravity of a hemisphere lie at a distance of \_\_\_\_\_, both from its base measured along vertical axis.

- (e) In a tensile test on mild steel specimen, the yield stress is \_\_\_\_\_ than the ultimate stress and the breaking stress is \_\_\_\_\_ than the ultimate stress if all the stresses are calculated on the basis of initial cross-sectional area of the specimen.

**Match the columns for the following three parts :**

You will be awarded full marks, if all the matches in a part are correct otherwise will be awarded zero.

- (f) Match the following columns :

**Column-I**

**Column-II**

- |                        |  |
|------------------------|--|
| (i) Coplanar forces    | (P) Line of action of all forces lie in the same plane and pass through a common point |
| (ii) Concurrent forces | (Q) Line of action of all forces lie in the same plane                                 |





(iii) Concurrent coplanar (R) Line of action of all forces \_\_\_\_\_ forces lie along the same line

(iv) Collinear forces (S) Line of action of all forces pass through a common point

(g) Column-II gives the mass moment of inertia of various solids about the central axis. Match the following columns :

#### Column-I

#### Column-II

(i) Cylinder

(P)  $3mr^2/2$

(ii) Sphere

(Q)  $3mr^2/10$

(iii) Cone

(R)  $2mr^2/5$

(iv) Thin circular disk (S)  $mr^2/2$

(h) Column-II gives maximum bending moments for the following loads. Match the following columns :

#### Column-I

#### Column-II

(i) Cantilever with point load at free end (P)  $Wl/4$

(ii) Cantilever with uniformly distributed load on the entire cantilever (Q)  $Wl^2/8$

(iii) Simple supported beam with point load at mid span (R)  $Wl$

(iv) Simple supported beam with uniformly distributed load on the entire beam (S)  $Wl^2/2$

Choose the correct answer for the following two parts :

(i) Consider the following statements :

(I) The magnitude of the moment does not change if the point of application of the force is transmitted along its line of action.



(II) The magnitude of the moment does not change if the moment centre is moved along a line parallel to the line of action of the force :

(i) I alone is correct

(ii) I & II are correct

(iii) II alone is correct

(iv) Neither I nor II correct

(j) Consider the following statements :

(I) In truss analysis the bars are connected at their ends by frictional hinges.

(II) In truss analysis the bars are assumed to be weightless.

(i) I alone is correct

(ii) I & II are correct

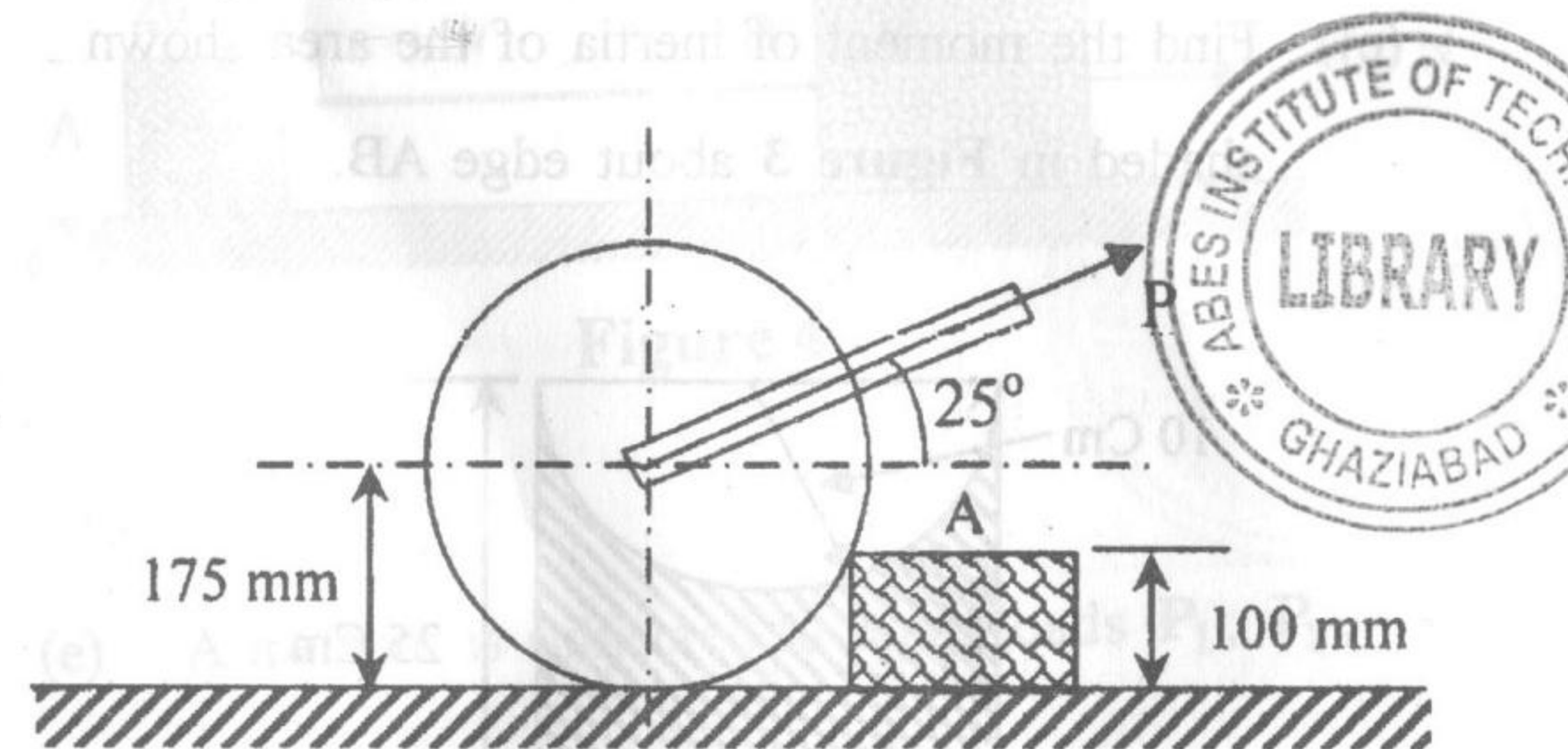
(iii) II alone is correct

(iv) Neither I nor II is correct

## SECTION - B

2 Answer any **three** parts of the following :  $10 \times 3 = 30$

(a) A roller shown in **Figure 1** is of mass 150 kg. What force  $P$  is necessary to start the roller over the block A ?

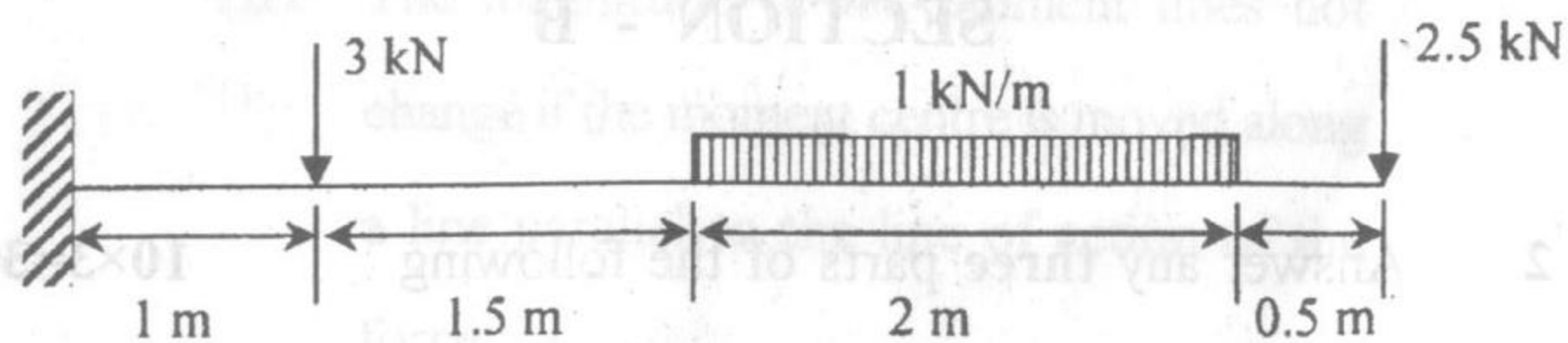


**Figure 1**

(b) Calculate the values of shear force and bending moments for the cantilever beam shown in **Figure 2**. Also draw the shear force and bending moment diagrams.

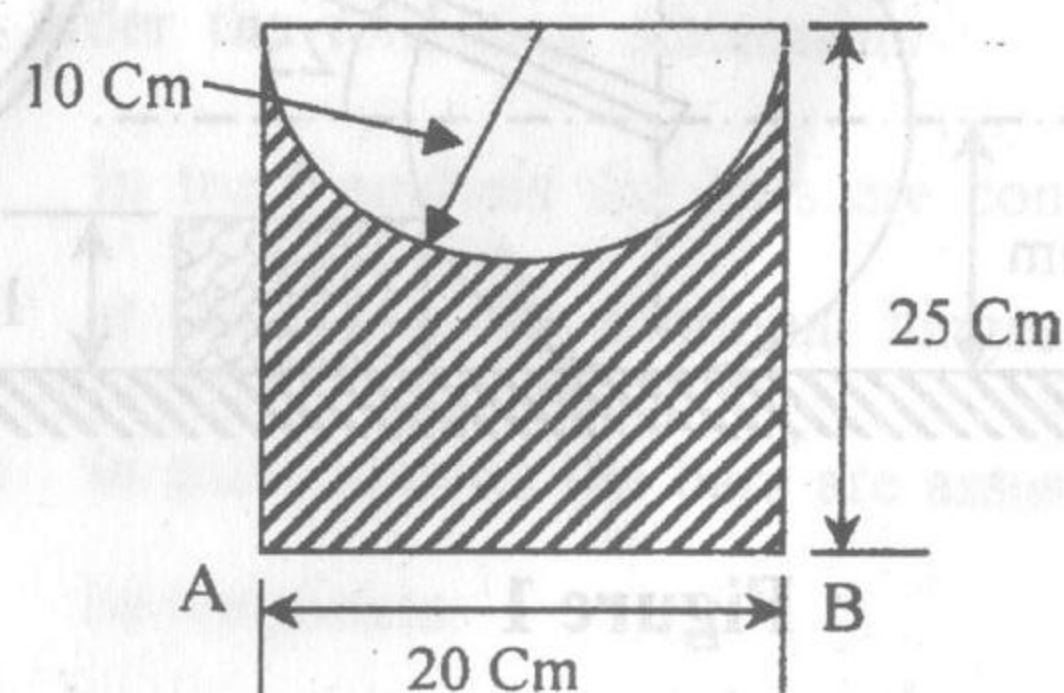






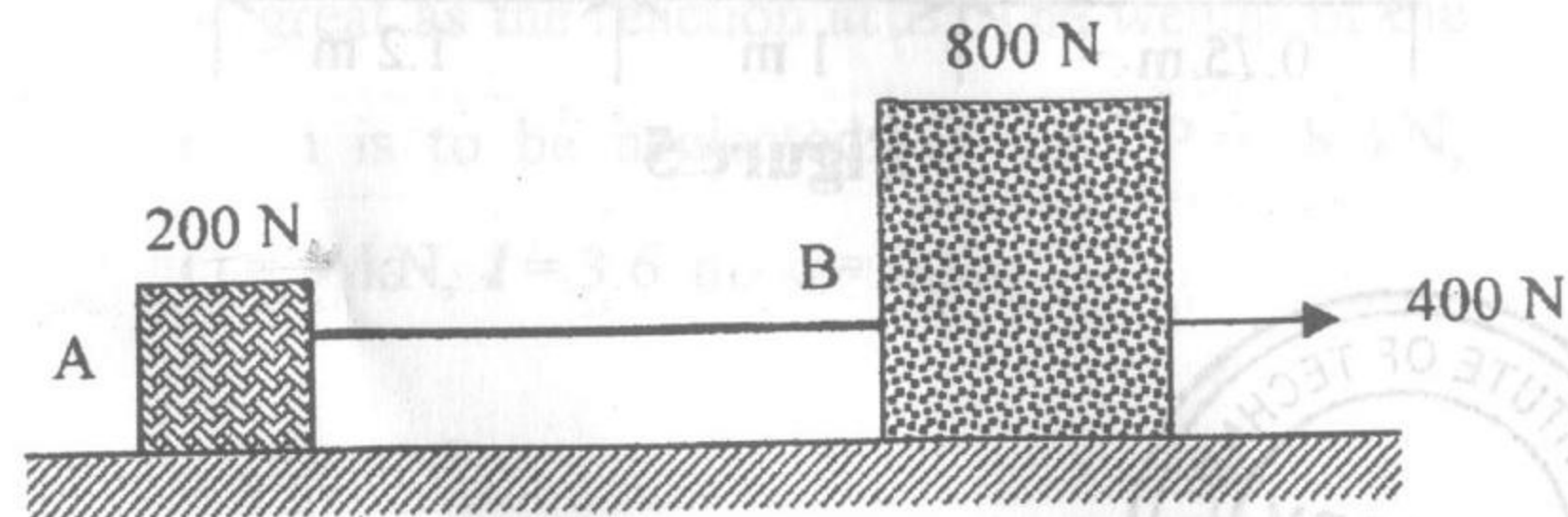
**Figure 2**

- (c) Find the moment of inertia of the area shown shaded in **Figure 3** about edge AB.



**Figure 3**

- (d) Two bodies A and B are connected by a thread and move along a rough horizontal plane ( $\mu = 0.3$ ) under the action of a force 400 N applied to the body B as shown in **Figure 4**.

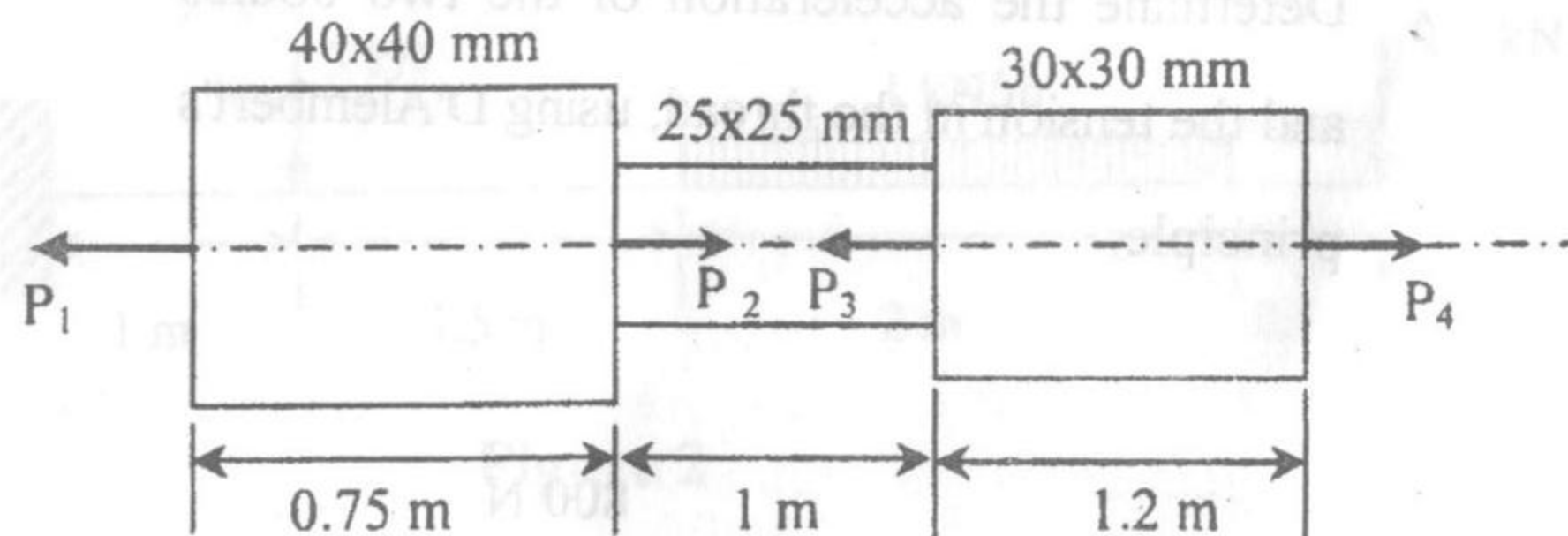


**Figure 4**

- (e) A member is subjected to point loads  $P_1$ ,  $P_2$ ,  $P_3$  and  $P_4$  as shown in **Figure 5**. Calculate the force  $P_3$  necessary for equilibrium if  $P_1=120 \text{ kN}$ ,  $P_2=220 \text{ kN}$  and  $P_4=160 \text{ kN}$ . Determine also the change in length of the member. Take  $E=2 \times 10^5 \text{ N/mm}^2$ .

Determine the acceleration of the two bodies and the tension in the thread, using D'Alembert's principle.





**Figure 5**



## SECTION - C

3 Answer any **two** parts of the following : 5×2=10

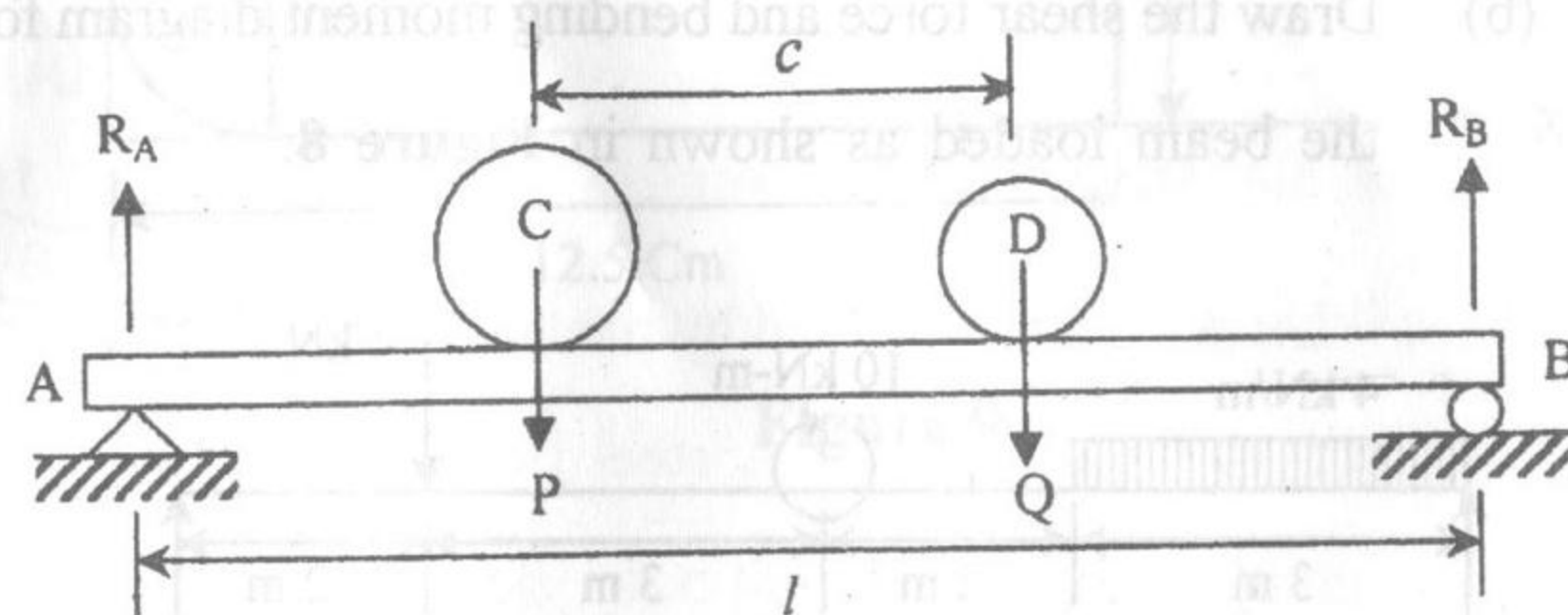
(a) Explain the following :

(i) Laws of static friction

(ii) Limiting angle of friction.

(b) What is a free body diagram ? Explain with suitable example.

(c) Two rollers C and D produce vertical forces P and Q on the horizontal beam AB, as shown in **Figure 6**. Determine the distance x of the load P from the support A if the reaction at A is twice as great as the reaction at B. The weight of the beam is to be neglected. Given :  $P = 18 \text{ kN}$ ,  $Q = 9 \text{ kN}$ ,  $l = 3.6 \text{ m}$ ,  $c = 0.9 \text{ m}$



**Figure 6**

4 Answer any **one** of the following : 10

(a) Find the axial forces in all members of a truss as shown in **Figure 7**.





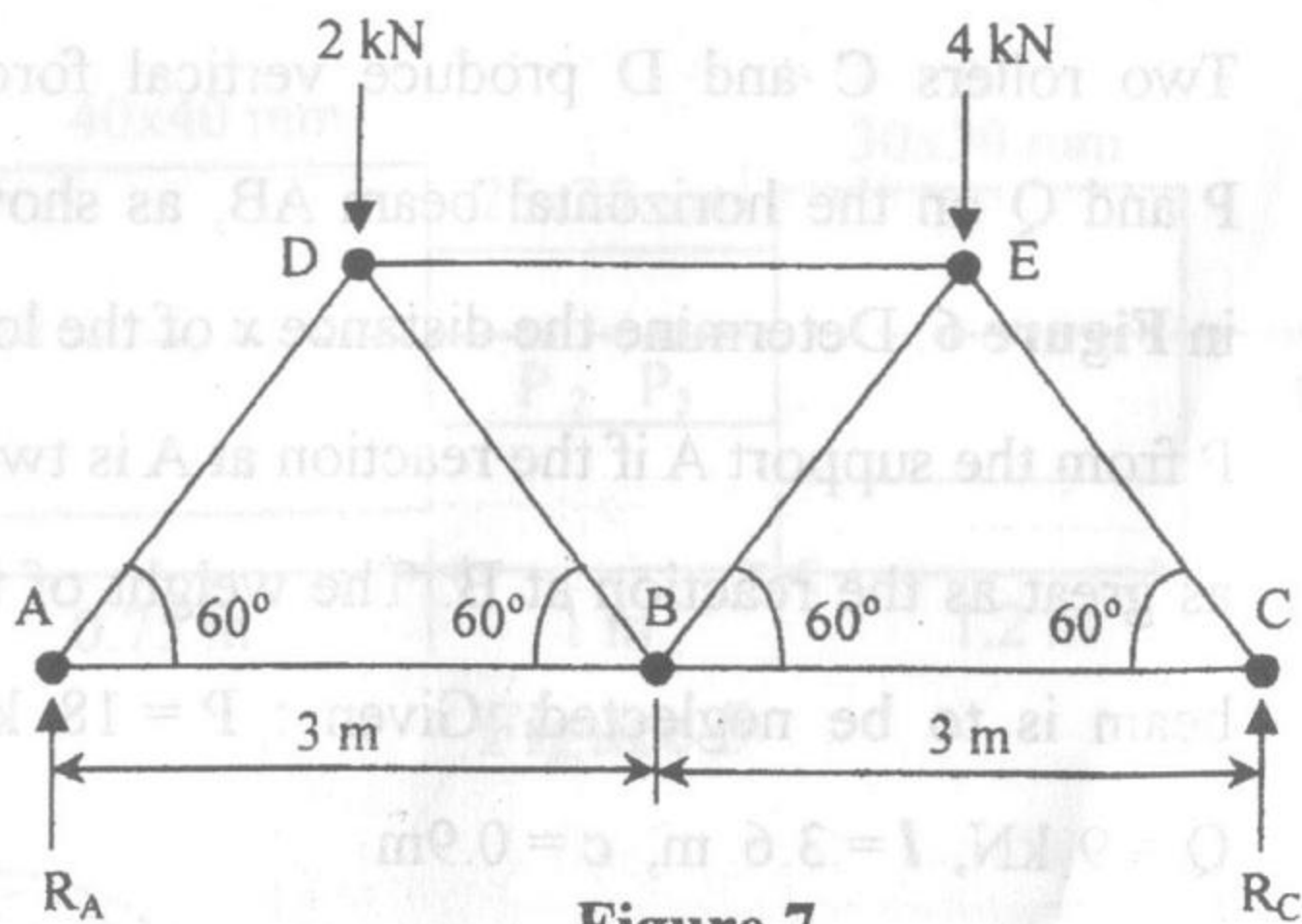


Figure 7

- (b) Draw the shear force and bending moment diagram for the beam loaded as shown in Figure 8.

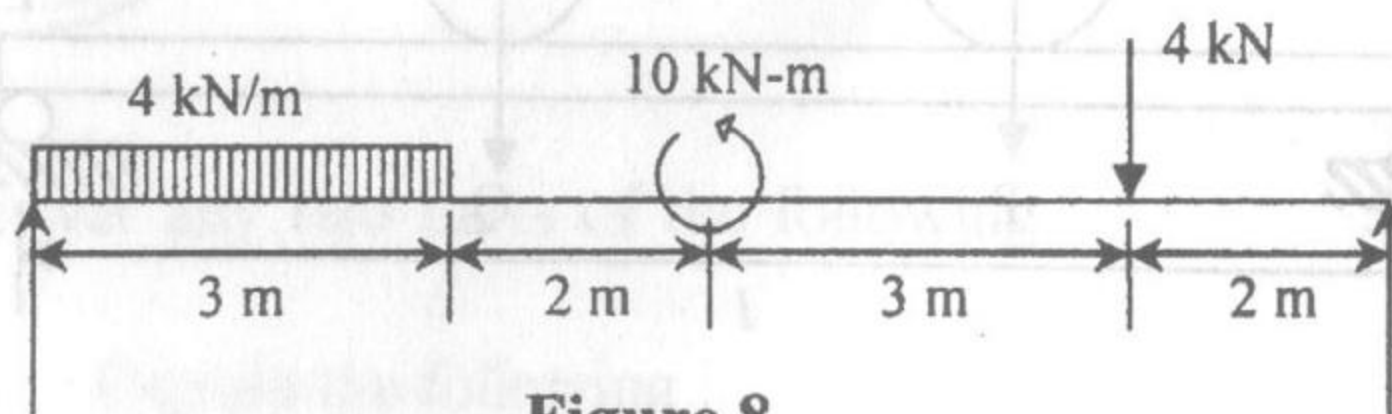


Figure 8

5 Answer any **two** parts of the following :  $5 \times 2 = 10$

- (a) Explain any **two** of the following :
- Parallel axis theorem
  - Product of inertia of an area about its axis of symmetry.
  - Centre of gravity.

- (b) Find the centroid of Figure 9.

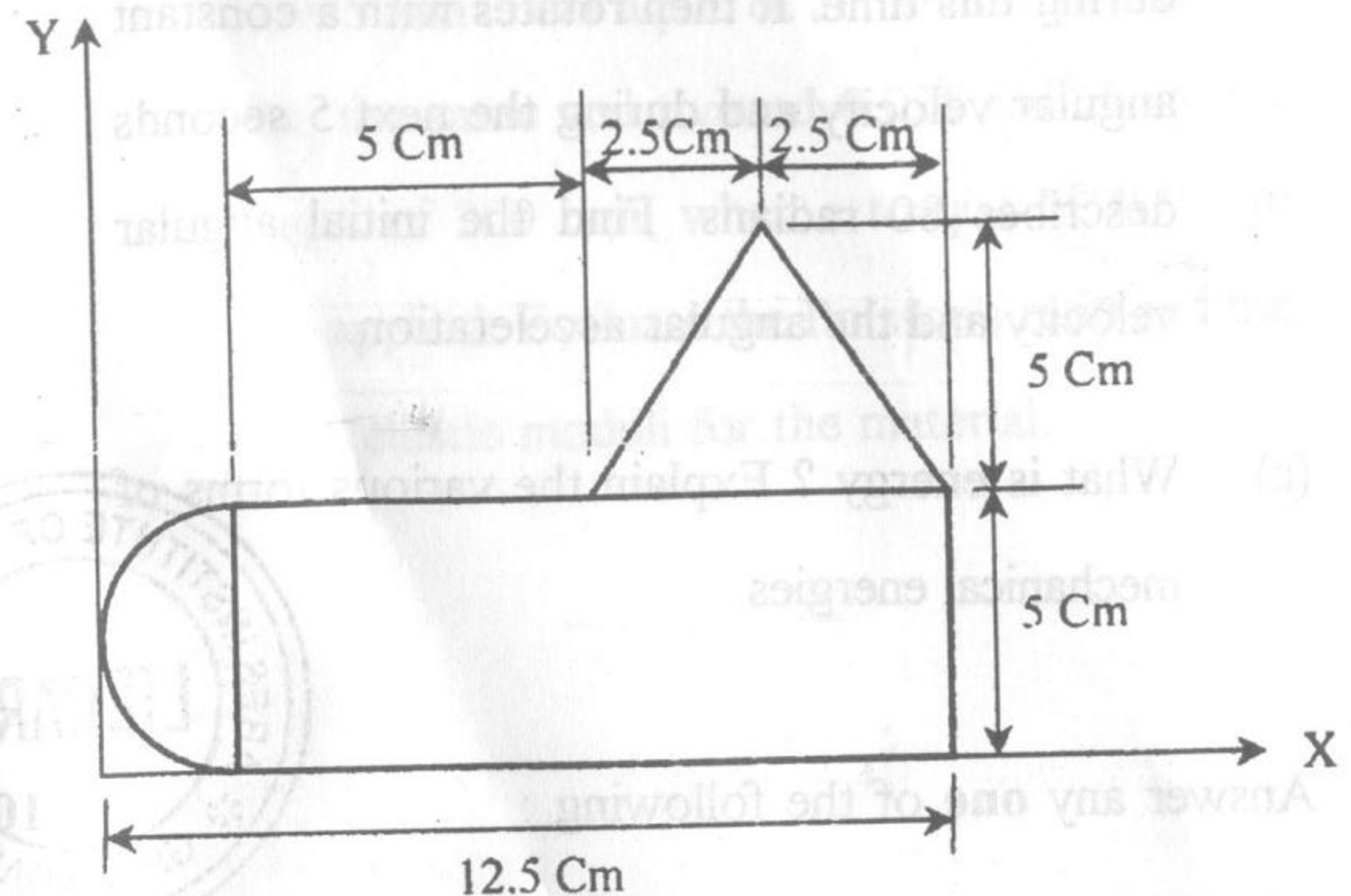


Figure 9

- (c) Derive an expression of mass moment of inertia of a cylinder about the longitudinal axis.

6 Answer any **two** parts of the following :  $5 \times 2 = 10$

- (a) What do you understand by the term kinematics ?  
Explain different types of plane motion of rigid bodies with suitable example.



- (b) A wheel rotates for 5 seconds with constant angular acceleration and describes 100 radians during this time. It then rotates with a constant angular velocity and during the next 5 seconds describes 80 radians. Find the initial angular velocity and the angular acceleration.
- (c) What is energy ? Explain the various forms of mechanical energies.



7

Answer any **one** of the following :

- (a) What do you understand by the term neutral axis and neutral surface ? A steel beam of hollow square section of 60 mm outer side and 50 mm inner side is simply supported on a span of 4 meters. Find the maximum concentrated load the beam can carry at the middle of the span if the bending stress is not to exceed  $120 \text{ N/mm}^2$ .
- (b) State the assumptions made in the theory of pure torsion.

In a tensile test, a test piece 25 mm in diameter, 200 mm gauge length stretched 0.0975 mm under a pull of 50,000 N. In a torsion test, the same rod twisted 0.025 radian over a length of 200 mm, when a torque of 400 Nm was applied. Evaluate the Poisson's ratio and the three elastic moduli for the material.

